

WHAT IS CLAIMED IS:

1. A piezoelectric loudspeaker comprising:

a piezoelectric vibrator including a diaphragm and a piezoelectric member provided on at least one face of the diaphragm, the diaphragm being vibrated by the piezoelectric member;

a frame for supporting the piezoelectric vibrator; and
a visco-elastic member provided on at least one face of the piezoelectric vibrator,

wherein the visco-elastic member is disposed in a substantial center of the piezoelectric vibrator, and

wherein the visco-elastic member has a bottom face area which accounts for about 11% to about 80% of a bottom face area of the diaphragm.

2. A piezoelectric loudspeaker according to claim 1,

wherein the visco-elastic member comprises two or more visco-elastic members stacked on top of each other, and

wherein the two or more types of visco-elastic members at least comprise different materials or different shapes.

3. A piezoelectric loudspeaker according to claim 1, wherein the visco-elastic member comprises first and second visco-elastic members which are provided on opposite sides of the piezoelectric vibrator.

4. A piezoelectric loudspeaker according to claim 3, wherein the first and second visco-elastic members at least comprise different materials or different shapes.

5. A piezoelectric loudspeaker according to claim 1,

wherein the visco-elastic member comprises two or more

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visco-elastic members having mutually different values in at least one of specific gravity, Young's modulus, and internal loss, and

wherein the two or more types of visco-elastic members are disposed in a concentric manner.

6. A piezoelectric loudspeaker according to claim 1, wherein a rigid member is provided on the visco-elastic member, the rigid member having a specific gravity which is larger than a specific gravity of the visco-elastic member.

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7. A piezoelectric loudspeaker according to claim 1, wherein the piezoelectric vibrator has at least one aperture, the at least one aperture being at least partially filled by the visco-elastic member.

8. A piezoelectric loudspeaker according to claim 1, wherein the frame has a horn-like configuration having an opening, the opening having a gradually increasing cross-sectional area away from the piezoelectric vibrator and toward a final opening at which soundwaves are emitted, and

wherein the visco-elastic member has a conical configuration having a gradually decreasing cross-sectional area away from the piezoelectric vibrator and toward the final opening.

9. A piezoelectric loudspeaker according to claim 1 further comprising an element provided in a central portion of the visco-elastic member, at least one of specific gravity and elastic modulus of the element being larger than specific gravity and/or elastic modulus of the visco-elastic member.

10. A piezoelectric loudspeaker according to claim 1, wherein the visco-elastic member includes notches at least in one portion thereof.

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~~11. A piezoelectric loudspeaker comprising:~~

~~a piezoelectric vibrator including a diaphragm and a piezoelectric member provided on at least one face of the diaphragm, the diaphragm being vibrated by the piezoelectric member;~~

~~a frame for supporting the piezoelectric vibrator; and~~

~~a support element for supporting the piezoelectric vibrator at a substantial center of the piezoelectric vibrator.~~

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12. A piezoelectric loudspeaker according to claim 11, wherein the support element includes a conductive portion which is in electrical contact with the piezoelectric vibrator, and an electrical input is applied to the conductive portion.

13. A piezoelectric loudspeaker according to claim 11 further comprising a visco-elastic member provided on at least one face of the piezoelectric vibrator.

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~~14. A piezoelectric loudspeaker comprising:~~

~~a piezoelectric vibrator including a diaphragm and a plurality of piezoelectric members provided on at least one face of the diaphragm, the diaphragm being vibrated by the plurality of piezoelectric members; and~~

~~a frame for supporting the piezoelectric vibrator, wherein different voltages are applied to at least two of the plurality of piezoelectric members.~~

15. A piezoelectric loudspeaker according to claim 14 further comprising a visco-elastic member provided on at least one face of the piezoelectric vibrator.

16. A piezoelectric loudspeaker according to claim 14, wherein at least one of the plurality of piezoelectric members receives an electric input via an electrical resistance.

17. A piezoelectric loudspeaker according to claim 14, wherein the plurality of piezoelectric members are defined by at least two split sections of the visco-elastic member provided on at least one face of the piezoelectric vibrator.

18. A piezoelectric loudspeaker according to claim 14, further comprising an electrically resistant element for interconnecting at least two of the plurality of piezoelectric members.

19. A piezoelectric loudspeaker according to claim 1 further comprising a plate for connecting at least one said visco-elastic member to the frame so as to damp unwanted vibration of the piezoelectric vibrator,

wherein an enclosed space is formed by the plate, the frame, and the diaphragm.

20. A piezoelectric loudspeaker according to claim 19, wherein the plate has at least through-hole.

21. A piezoelectric loudspeaker according to claim 19, wherein the visco-elastic member includes a conductive portion which is in electrical contact with the

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piezoelectric vibrator, and an electrical input is applied to the conductive portion.

22. A piezoelectric loudspeaker according to claim 1 further comprising a lead wire for applying an electric input to the piezoelectric member, wherein the piezoelectric vibrator has at least one through-hole through which the lead wire is coupled to the piezoelectric member.

23. A piezoelectric loudspeaker according to claim 1 further comprising a cover for protecting at least one said visco-elastic member and the piezoelectric vibrator.

24. A piezoelectric loudspeaker according to claim 23 further comprising a conductive terminal for applying an electrical input to the piezoelectric member, the conductive terminal being provided within the cover.

~~25. A piezoelectric loudspeaker comprising:~~

~~a piezoelectric vibrator including a diaphragm and a piezoelectric member provided on at least one face of the diaphragm, the diaphragm being vibrated by the piezoelectric member;~~

~~a frame for supporting the piezoelectric vibrator; and
a visco-elastic member provided on at least one face of the piezoelectric vibrator,~~

~~wherein the visco-elastic member is disposed in a substantial center of the piezoelectric vibrator,~~

~~wherein the visco-elastic member has a bottom face area which accounts for about 11% to about 80% of a bottom face area of the diaphragm, and~~

~~wherein the bottom face area of the visco-elastic member is equal to or greater than the bottom face area of the~~

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